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NASA Procedural Requirements

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Request Notification of Change

 (NASA Only)

Subject: NASA Systems Engineering Processes and Requirements

Responsible Office: Office of the Chief Engineer

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Appendix D. Systems Engineering Management Plan

D.1 Purpose and Use

The purpose of this appendix is to provide an annotated outline for a SEMP for use by NASA in planning the technical effort required for in-house and contracted projects. The SEMP is the technical planning document for systems engineering. The SEMP is designed to be a single, integrated technical planning document for the conduct and management of the required technical effort that is the responsibility of an in-house NASA project. The resulting technical plan is to represent the agreed-to and approved tailoring of the requirements of the SE NPR to satisfy project technical requirements. The plan is to be used by the technical team responsible for generating technical work products to integrate and manage the full spectrum of technical activities required to engineer the system covered by the SEMP. The SEMP should be coordinated with the project plan for integration of the technical planning and modifications related to the allocated resources, including cost, schedule, personnel, facilities, and deliverables required. The plan will also be used to evaluate the team's technical approach, to make technical risk assessments, and to measure progress.

D.2 Terms Used

Terminology is a key factor in ensuring a common understanding of the technical effort to be accomplished. Terms used in the SEMP must have the same meaning as the terms used in the SE NPR.

D.3 SEMP Preparation

D.3.1 Outline Use

The SEMP outline in this appendix is to be used in preparing a project SEMP. For a small project the material in the SEMP can be placed in the project plan's technical summary and this annotated outline used as a topic guide.

D.3.2 Tailoring and Waivers

D.3.2.1

SEMP tailoring is to be consistent with the SE NPR tailoring requirements and guidelines. (See Appendix F.) The SEMP is to include documentation of any tailoring to the SE NPR requirements and SEMP sections or subsections. Tailoring is an adaptation of a process or approach to meet a requirement, whereas a waiver is a documented agreement intentionally releasing a program or project from meeting a requirement. Tailored requirements will be documented directly following the heading of each affected SEMP section or subsection. Tailored SE NPR requirements that are not directly related to a SEMP section or subsection will be documented in the waiver section.

D.3.2.2

Approved waivers will be documented and incorporated into the waiver section of the SEMP.

D.3.3 Surveillance-Type Projects

For projects with significant portions of the engineering work contracted out, the SEMP should scope and plan the NASA project's implementation of the common technical processes before, during, and at the completion of the contracted effort. This should include planning the technical team's involvement in RFP preparation, in source selection activities, and in acceptance of deliverables. The interface activities with the contractor, including NASA technical team involvement with and monitoring of contracted work, should be a focus of the SEMP.

D.4 SEMP Annotated Outline

D.4.1 General Structure

The SEMP contains the following sections, unless they have been tailored out. Cross references to detailed information in related technical plans are included in each pertinent SEMP section.

- a. Purpose and Scope.
- b. Applicable Documents and Designated Governing Authority.
- c. Technical Summary.
- d. Technical Effort Integration.
- e. Common Technical Processes Implementation.
- f. Technology Insertion.
- g. Additional SE Functions and Activities.
- h. Integration with the Project Plan Resource Allocation.
- i. Waivers.
- j. Appendices.

D.4.2 Purpose and Scope

This section provides a brief description of the purpose, scope, and content of the SEMP. The scope encompasses the SE technical effort required to generate the work products necessary to meet the exit criteria for the product-line life-cycle phases.

D.4.3 Applicable Documents

This section lists the documents applicable to SEMP implementation and describes major standards and procedures that the technical effort needs to follow. Specific implementation of standardization tasking is incorporated into pertinent sections of the SEMP.

D.4.4 Technical Summary

This section contains an executive summary describing the problem to be solved by this technical effort.

D.4.4.1 System Description

This subsection contains a definition of the purpose of the system being developed and a brief description of the purpose of the products of the WBS models of the system structure for which this SEMP applies. Each WBS model includes the system end products and their subsystems and the supporting or enabling products and any other work products (plans, baselines) required for the development of the system. The description should include any interfacing systems and system products, including humans, with which the WBS model system products will interact physically, functionally, or electronically.

D.4.4.2 System Structure

This subsection contains an explanation of how the WBS models will be developed, how the resulting WBS model will be integrated into the project WBS, and how the overall system structure will be developed. This subsection contains a description of the relationship of the specification tree and the drawing tree with the products of the system structure and how the relationship and interfaces of the system end products and their life-cycle-enabling products will be managed throughout the planned technical effort.

D.4.4.3 Product Integration

This subsection contains an explanation of how the product will be integrated and will describe clear organizational responsibilities and interdependencies whether the organizations are geographically dispersed or managed across Centers.

D.4.4.4 Planning Context

This subsection contains the product-line life-cycle model constraints (e.g., NPR 7120.5) that affect the planning and implementation of the common technical processes to be applied in performing the technical effort. The constraints provide a linkage of the technical effort with the applicable product-line life-cycle phases covered by the SEMP including, as applicable, milestone decision gates, major technical reviews, key intermediate events leading to project completion, life-cycle phase, event entry and exit criteria, and major baseline and other work products to be delivered to the sponsor or customer of the technical effort.

D.4.4.5 Boundary of Technical Effort

This subsection contains a description of the boundary of the general problem to be solved by the technical effort. Specifically, it identifies what can be controlled by the technical team (inside the boundary) and what influences the technical effort and is influenced by the technical effort but not controlled by the technical team (outside the boundary). Specific attention should be given to physical, functional, and electronic interfaces across the boundary.

D.4.4.6 Cross-References

This subsection contains cross-references to appropriate nontechnical plans that interface with the technical effort and contains a summary description of how the technical activities covered in other plans are accomplished as fully integrated parts of the technical effort.

D.4.5 Technical Effort Integration

This section contains a description of how the various inputs to the technical effort will be integrated into a coordinated effort that meets cost, schedule, and performance objectives.

D.4.5.1 Responsibility and Authority

This subsection contains a description of the organizing structure for the technical teams assigned to this technical effort and includes how the teams will be staffed and managed, including: (a) what organization/panel will serve as the DGA for this project and, therefore, will have final signature authority for this SEMP; (b) how multidisciplinary teamwork will be achieved; (c) identification and definition of roles, responsibilities, and authorities required to perform the activities of each planned common technical process; (d) planned technical staffing by discipline and expertise level, with human resource loading; (e) required technical staff training; and (f) assignment of roles, responsibilities, and authorities to appropriate project stakeholders or technical teams to assure planned activities are accomplished.

D.4.5.2 Contractor Integration

This subsection contains a description of how the technical effort of in-house and external contractors is to be integrated with the NASA technical team efforts. This includes establishing technical agreements, monitoring contractor progress against the agreement, handling technical work or product requirements change requests, and

acceptance of deliverables. The section will specifically address how interfaces between the NASA technical team and the contractor will be implemented for each of the 17 common technical processes. For example, it addresses how the NASA technical team will be involved with reviewing or controlling contractor-generated design solution definition documentation or how the technical team will be involved with product verification and product validation activities.

D.4.5.3 Support Integration

This subsection contains a description of the methods (such as integrated computer-aided tool sets, integrated work product databases, and technical management information systems) that will be used to support technical effort integration.

D.4.6 Common Technical Processes Implementation

Each of the 17 common technical processes will have a separate subsection that contains the plan for performing the required process activities as appropriately tailored. (See Chapter 3 for the process activities required and Appendix F for tailoring.) Implementation of the 17 common technical processes includes: (1) generating outcomes needed to satisfy the entry and exit criteria of the applicable product-line life-cycle phase or phases identified in D.4.4.4 and (2) producing the necessary inputs for other technical processes. These sections contain a description of the approach, methods, and tools for:

- a. Identifying and obtaining adequate human and nonhuman resources for performing the planned process, developing the work products, and providing the services of the process.
- b. Assigning responsibility and authority for performing the planned process, developing the work products, and providing the services of the process.
- c. Training the technical staff performing or supporting the process, where training is identified as needed.
- d. Designating and placing designated work products of the process under appropriate levels of configuration management.
- e. Identifying and involving stakeholders of the process.
- f. Monitoring and controlling the process.
- g. Objectively evaluating adherence of the process and the work products and services of the process to the applicable requirements, objectives, and standards and addressing noncompliance.
- h. Reviewing activities, status, and results of the process with appropriate levels of management and resolving issues.

D.4.7 Technology Insertion

This section contains a description of the approach and methods for identifying key technologies and their associated risks and criteria for assessing and inserting technologies, including those for inserting critical technologies from technology development projects.

D.4.8 Additional SE Functions and Activities

This section contains a description of other areas not specifically included in previous sections but that are essential for proper planning and conduct of the overall technical effort.

D.4.8.1 System Safety

This subsection contains a description of the approach and methods for conducting safety analysis and assessing the risk to operators, the system, the environment, or the public.

D.4.8.2 Engineering Methods and Tools

This subsection contains a description of the methods and tools not included in D.4.7 that are needed to support the overall technical effort and identifies those tools to be acquired and tool training requirements.

D.4.8.3 Specialty Engineering

This subsection contains a description of engineering discipline and specialty requirements that apply across

projects and the WBS models of the system structure. Examples of these requirement areas include planning for safety, reliability, human factors, logistics, maintainability, quality, operability, and supportability.

D.4.9 Integration with the Project Plan and Technical Resource Allocation

This section contains how the technical effort will integrate with project management and defines roles and responsibilities. This section addresses how technical requirements will be integrated with the project plan to determinate the allocation of resources, including cost, schedule, and personnel, and how changes to the allocations will be coordinated.

D.4.10 Waivers

This section contains all approved waivers to the Center Director's SE NPR Implementation Plan requirement for the SEMP. This section also contains a separate subsection that includes any tailored SE NPR requirements that are not related and able to be documented in a specific SEMP section or subsection.

D.4.11 Appendices

Appendices are included, as necessary, to provide a glossary, acronyms and abbreviations, and information published separately for convenience in document maintenance. Included would be: (a) information that may be pertinent to multiple topic areas (e.g., description of methods or procedures); (b) charts and proprietary data applicable to the technical efforts required in the SEMP; and (c) a summary of technical plans associated with the project. Each appendix should be referenced in one of the sections of the engineering plan where data would normally have been provided.

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